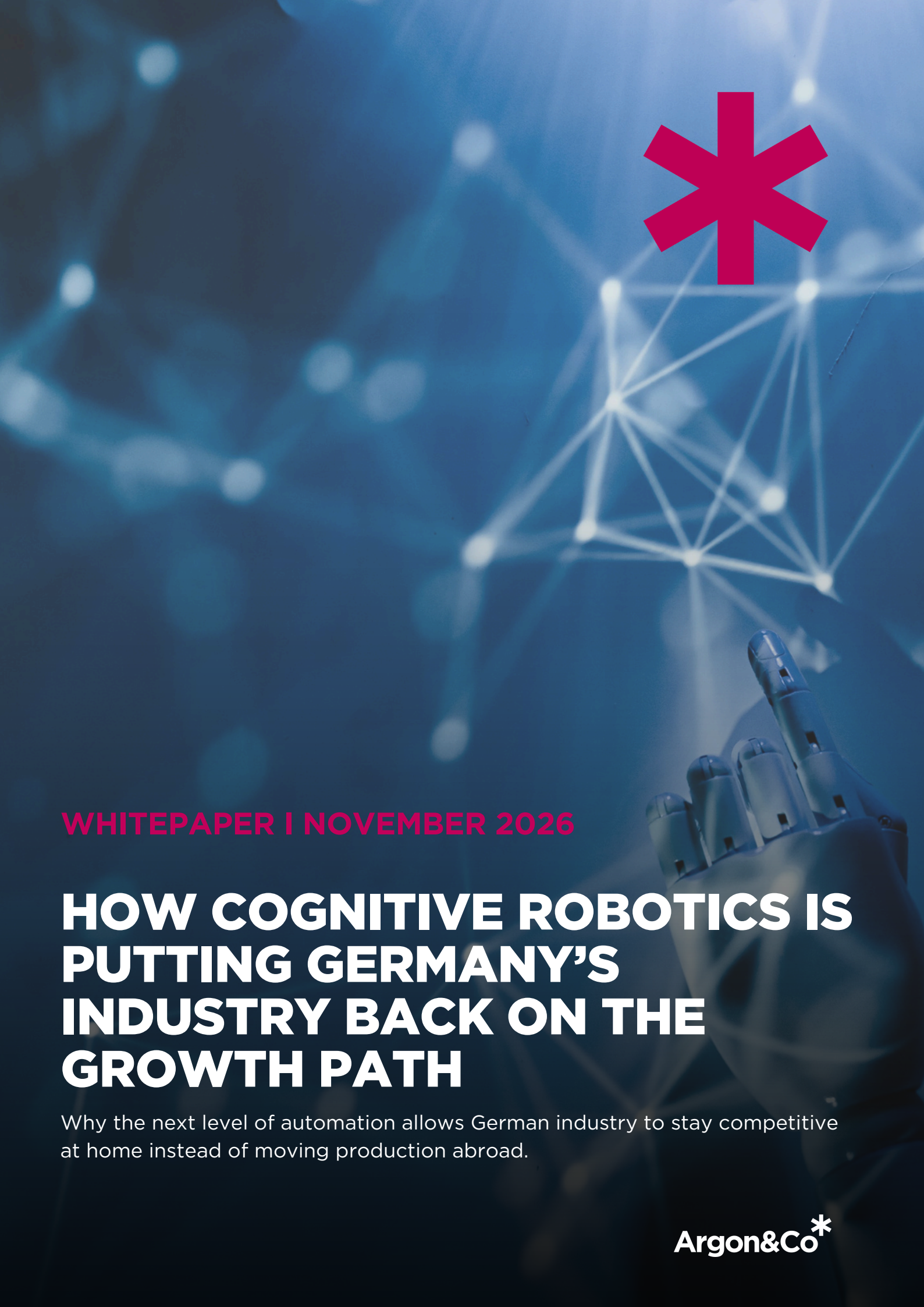


WHITEPAPER I NOVEMBER 2026

HOW COGNITIVE ROBOTICS IS PUTTING GERMANY'S INDUSTRY BACK ON THE GROWTH PATH

Why the next level of automation allows German industry to stay competitive at home instead of moving production abroad.

Argon&Co

Executive Summary

Industrial value creation is increasingly moving abroad.

Around 1,300 German companies with 50+ employees relocated business functions abroad alone in the years 2021–2023, costing about 50,800 domestic jobs [1].

The trend is accelerating.

In 2026 about 60% of large industrial companies are reducing production in Germany or shifting it abroad (planned, ongoing, or completed) [2].

The causes are structural:

Manufacturing labor costs that are the third highest in the EU, high energy costs, regulation, and skilled labor vacancies that cannot be filled [3][4].

Cognitive robotics changes the equation.

It automates semi-structured, human-centric work in existing brownfield sites and scales through transferable skills.

It works in live production today.

Successful deployments in real production environments, including automotive manufacturing and factory logistics [14][18].

Argon & Co identifies the right use cases, pilots cognitive robotics at speed, and supports deployment in production by specialists.

2. German industry is voting with its feet

2.1. Relocation has moved from threat to execution

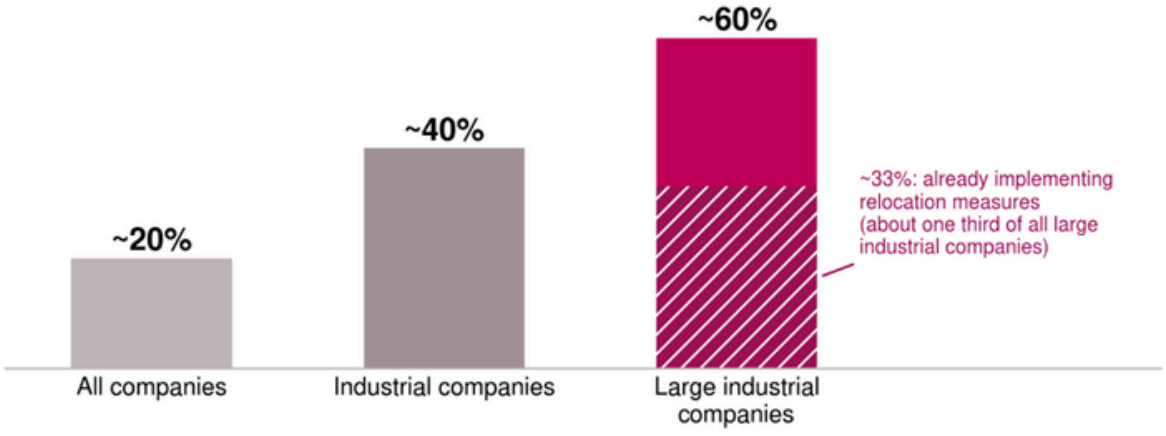
For years, relocation was a bargaining chip in negotiations with unions and policymakers. That has changed. Around 1,300 German companies with 50 or more employees relocated business functions abroad between 2021 and 2023, equivalent to 2.2% of all companies of that size, at a cost of net approximately 51,000 domestic jobs [1].

The movement is gaining momentum. About 20% of German companies are reducing their production in Germany or shifting production abroad, whether at the planning stage, in implementation, or already completed. In industry, the figure rises to about 40%, and among large industrial enterprises to approximately 60%; about one third of large industrial enterprises are already implementing such measures [2]. At the same time, 43% of industrial companies plan foreign investments in 2026, while the share investing abroad primarily to develop new markets fell slightly from 30% to 28% [1]. In other words, foreign investment is increasingly driven by cost, not growth.

> "Companies are now being forced to invest abroad primarily for cost reasons. This frequently leads to significant cutbacks at domestic sites."
>
> *Source: Volker Treier, Head of International Trade, DIHK, quoted in DW, "Are German companies leaving the country?" (2026) [1]*

Exhibit 1: Relocation pressure rises with company size and industrial intensity

Share of companies relocating investments or production capacity abroad (considering, in implementation, or already implemented), 2026



Note: nested respondent groups; each share refers to the total of the respective group.
Source: DIHK Energiewende-Barometer 2026 (approx. 3,100 companies surveyed, June 8–29, 2026)

2.2. Landmark cases

Some of Germany's best-known industrial names illustrate relocation, domestic restructuring and overseas investment:

Company	Case
Volkswagen	Production of the Golf and Golf Variant will move from Wolfsburg to Puebla, Mexico, from 2027. Puebla is being retooled with reused robots and welding equipment from European sites, including Neckarsulm and Emden [7].
BASF	BASF announced closures at Ludwigshafen in 2023, including one of its two ammonia plants and additional closures scheduled for 2025. [8][9]. In March 2026 it inaugurated the €8.7 billion Zhanjiang site, employing more than 2,000 people and primarily serving Chinese customers. [10].
Mercedes-Benz	The company invested €1 billion to double output in Kecskemét, Hungary, making it its largest plant in Europe, with the electric C-Class, electric GLC, and small G-Class built or planned there. Hungarian employment costs remain far below Western European levels [11].
Bosch Power Tools	Bosch announced plans to close the specified Power Tools production operations in Leinfelden-Echterdingen and Sebnitz by end-2026, affecting about 500 employees. A significant share of production will continue at its plant in Miskolc, Hungary [12].
Miele	Miele announced plans to transfer assembly of almost all domestic washing machines from Gütersloh to Ksawerów in stages through 2027, affecting around 700 jobs. [13].

2.3. The root cause: a structural cost and capacity gap

Companies cite a familiar list of location disadvantages: regulation and long approval times, energy costs, lack of political continuity, aging infrastructure, the tax burden, high non-wage labor costs, and a shortage of skilled workers. Four data points quantify the gap:

Labor costs: One hour worked in German manufacturing cost €49.50 in 2025, the third highest level in the EU, compared with an EU average of €35.00, €20.20 in the Czech Republic, €17.10 in Poland, and €15.60 in Hungary [3]. A German manufacturing hour therefore costs roughly 2.9 times as much as in Poland and 3.2 times as much as in Hungary.

Energy: Around two thirds of industrial companies say the energy transition and its associated costs hinder their competitiveness, and about one third of all companies are postponing investments in their core processes [2].

Skilled labor: In 2025, an average skills mismatch, equivalent to approximately 370,000 job openings, could not be filled by suitably qualified applicants, including over 225,000 positions requiring completed professional training [4].

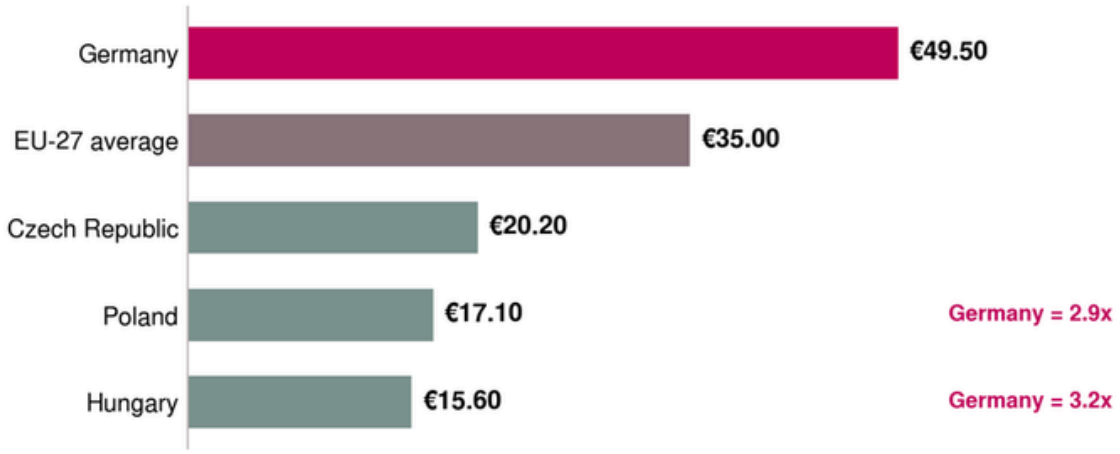
Demographics: 12.9 million economically active people, just under 30% of the workforce, will have reached retirement age by 2036 [5].

"Global crises are colliding with unresolved structural challenges in Germany as a business location. This keeps energy costs high. The consequences are declining competitiveness, postponed investments, and the relocation of production capacities abroad."

Source: Peter Adrian, President, DIHK, press release on the Energy Transition Barometer 2026, July 27, 2026 [2]

Exhibit 2: German manufacturing labor costs are ~3x those in Poland or Hungary

Labor cost per hour worked in manufacturing, 2025 (EUR)



Source: Destatis, labor cost comparison across EU countries (based on Eurostat), as at April 29, 2026

Energy prices, taxes, regulation, and infrastructure are largely in the hands of policymakers. Three levers, however, are within management's direct control: the cost of labor per unit produced, the availability of labor, and productivity. This is where cognitive robotics makes a difference.

3. Cognitive robotics as the lever to produce competitivly in Germany

3.1. Why conventional automation has reached its limit

Germany is already one of the most automated economies in the world. With about 450 industrial robots per 10,000 manufacturing employees, it ranks third globally behind the Republic of Korea and Singapore [6]. Yet classic industrial robots are programmed for fixed, highly structured tasks in fenced cells. The manual work that remains in German plants is, by its nature, the work that resists this kind of automation: variable parts, changing sequences, and workflows shared with people. In high-mix, low-volume production, rigid automation alone can no longer close these gaps economically.

3.2. What cognitive robotics is about

Cognitive robotics extends automation into dynamic operating environments. It combines cognitive perception, planning and adaptive control to perform defined tasks under variable conditions. Such capabilities can be implemented in robotic arms, mobile manipulators or humanoid platforms. In the best case, capabilities and training are supported by a digital-first software stack and a digital environment in which robot skills are developed, tested, and optimized before they reach the shop floor. Three capabilities set it apart:

It reaches work that traditional robots could not. Perception, AI-based decision-making, and adaptive behavior make semi-structured, human-centric workflows automatable.

It is brownfield-ready. Robots are deployed with almost no – or even without – site redesign, unlocking automation in existing environments and production layouts.

It scales without reprogramming. A transferable task library allows flexible deployment and 1:n roll-outs: a skill developed once can be replicated across comparable stations, lines, and sites.

Exhibit 3: Cognitive robotics reaches work that classic robots cannot

	CLASSIC INDUSTRIAL ROBOTICS	COGNITIVE ROBOTICS
Task type	Fixed, highly structured, repetitive	Semi-structured, variable, human-centric
Intelligence	Pre-programmed motion paths	Perception, AI decisions, adaptive behavior
Work environment	Fenced cells, separated from people	Shared workspaces alongside employees
Site requirements	Greenfield or line redesign	Brownfield-ready, no site redesign
Engineering	Programmed cell by cell	Skills developed and tested digitally
Scaling	One-off integration per cell	Transferable task library, 1:n roll-outs

Source: Argon & Co

3.3. How cognitive robotics closes the location gap

Each capability maps directly to the cost and capacity gap described in Section 2:

Location problem	How cognitive robotics responds
High labor and non-wage labor costs	Tasks performed by robots carry neither wages nor non-wage labor costs. In a Robotics-as-a-Service (RaaS) model, the cost of an automated task can become a predictable monthly fee (aaS, OpEx instead of CapEx).
Shortage of skilled workers	Robots take over simple, repetitive, and ergonomically demanding tasks. Automating suitable repetitive tasks can free skilled employees to focus on e.g. quality, process improvement and robot supervision, supported by training and redesigned roles. [14].
Productivity gap	Depending on process design, robots can operate three shifts, 24/7. They do not need breaks, do not fall ill, do not go on vacation, and deliver steady performance.
Investment risk and speed	Brownfield deployment avoids plant redesign. Reusable skills and simulation support early feasibility assessment and reduce integration risks, followed by on-site

3.4. From pilot to scale: an operating model that lowers the entry barrier

New delivery models make cognitive robotics accessible beyond large OEMs. Specialized consultants identify industrial processes and use cases for automation and calculate the business case. Deployment specialists refine each application in simulation within the customer's process environment and can operate the solution as a service over its entire runtime, with robot skills that continue to improve during operation and data hosted in a sovereign cloud in the EU. Several deployment partners also develop skills for special or individual purposes together with robot OEMs, from collaborative robot arms to humanoids, and take responsibility across the entire lifecycle from deployment to daily operations [16].

4. Cognitive robotics in live production

Cognitive robotics is in its early phase of industrial adoption, and publicly documented results come from pilots and first serial deployments. The evidence nonetheless shows that the technology performs in real production environments, including Germany. Industry expectations are high: Based on a recent survey of industrial companies, 58% believe humanoid robots could help close skilled labor gaps [17].

4.1. Automotive: from US pilot to the first humanoid German plant

At BMW's Plant Spartanburg, a humanoid robot was deployed for 11 months on an active assembly line, loading sheet-metal parts into welding fixtures within a 5-millimeter tolerance. Running 10-hour shifts Monday to Friday, it loaded more than 90,000 parts over more than 1,250 hours of runtime and contributed to the production of over 30,000 BMW X3 vehicles [15]. BMW is now extending its evaluation to Germany: a pilot with Hexagon's AEON humanoid at Plant Leipzig targets high-voltage battery assembly and component manufacturing, with the pilot phase started in summer 2026. A new Center of Competence for Physical AI in Production evaluates technology partners under real production conditions. BMW positions humanoid robots as a complement to existing automation, particularly for monotonous, ergonomically demanding, or safety-critical tasks [14].

"Digitalisation improves the competitiveness of our production – here in Europe and worldwide. The symbiosis of engineering expertise and artificial intelligence opens up entirely new possibilities in production."

Source: Milan Nedeljković, Member of the Board of Management of BMW AG, Production, BMW Group press release, February 27, 2026 [14]

4.2. Electronics production: successful proof of concept in a German factory

In January 2026, Siemens and the UK robotics company Humanoid completed a proof of concept at the Siemens Electronics Factory in Erlangen. After a development phase using a physical twin, a wheeled humanoid robot was deployed on site for two weeks in a real production environment. It autonomously picked totes from a storage stack, transported them to a conveyor, and placed them at the pickup point for human operators. All target metrics were met in full, including a throughput of 60 tote moves per hour, uptime exceeding eight hours, and pick-and-place success rates above 90% [18]. Other German manufacturers are moving in the same direction: Schaeffler announced to deploy a four-digit number of Humanoid's robots in its plants worldwide by 2032 under a Robotics-as-a-Service model, with the first systems going live at its Herzogenaurach and Schweinfurt sites from December 2026 [19].

"The technology is ready for practical use. The timing of adoption will determine competitive positioning over the next decade."

Source: Mathias Stach, CEO and Co-Founder, Auroniq Robotics, Productivity Symposium, May 2026 [20]

Exhibit 4: Humanoid proof of concept at Siemens Electronics Factory Erlangen

Autonomous tote-to-conveyor destacking in live intralogistics; all target metrics met in full



Source: Robotics 24/7, "Humanoid, Siemens complete proof of concept to test humanoid robots in industrial logistics", January 16, 2026

5. From relocation to automation: securing Germany as a production location

German industry cannot close a labor cost gap of up to 3x with its Central European neighbors through wage restraint alone, and it is costly to wait for policymakers to resolve energy prices, regulation, and infrastructure. Cognitive robotics offers opportunities in areas that German industry controls itself: it lowers the cost per unit of labor-intensive tasks, compensates for workers who cannot be hired, and runs around the clock, in the plant layouts Germany already has.

> "Cognitive robotics allows companies to close a large part of the cost gap where they are today, in their existing plants, with their existing teams and with ROIs in less than two years. The question is no longer whether to automate, but how fast."
>
> *Source: Dr. Michael Müller, Partner, Argon & Co, October 2026*

Classic automation made Germany one of the most automated economies in the world. The next step is to elevate automation with cognitive robots, before relocation decisions become irreversible. We recommend that executive teams take three steps:

Identify: Map manual work across plants and prioritize semi-structured tasks by cost, staffing risk, and technical feasibility.

Pilot: Validate two or three high-value use cases in simulation, then prove the business case in live production within months, not years.

Scale: Roll out proven skills 1:n across comparable lines and sites, and embed cognitive robotics among the options evaluated in relevant production-network and location decisions.

How we can help

The automation experts of Argon & Co identify the relevant use cases for automation in your operations, build the business case, pilot cognitive robotics together with specialized partners, and support the arrangement of the deployment of the robots in your production.

Contact



Dr. Michael Mueller

Partner

michael.mueller@argonandco.com

Argon & Co

Lichtstraße 25 I 50825 Cologne

About Argon & Co

Argon & Co is a global management consultancy that specialises in operations strategy and transformation. With expertise spanning supply chain planning, manufacturing, logistics, procurement, finance, and shared services, we work together with clients to transform their businesses and generate real change. Our people are engaging to work with and trusted by clients to get the job done. We have offices across Europe, Australasia, America, Asia and the Middle East.

argonandco.com

Sources

[1] DW, “Are German companies leaving the country?”, 2026 (citing Destatis data and the DIHK business climate survey, early 2026). dw.com/en/are-german-companies-leaving-the-country/a-77875399

[2] DIHK, “Energy Costs: One-third of Large Industrial Enterprises Already Shifting Production Abroad” (Energy Transition Barometer 2026), July 27, 2026. dihk.de

[3] Destatis, “Labour cost comparison across EU countries: labour costs per hour worked in 2025”, as at April 29, 2026 (based on Eurostat). destatis.de

[4] IW / KOFA, “KOFA Kompakt 3/2026: Jahresrückblick 2025”, 2026. iwkoeln.de

[5] Destatis, “12.9 million economically active people will reach statutory retirement age by 2036”, press release, August 2022. destatis.de

[6] International Federation of Robotics (IFR), “Robot Density Surges in Europe, Asia, and Americas” (World Robotics 2025), April 8, 2026. ifr.org

[7] Automotive Manufacturing Solutions, “Farewell from Wolfsburg: Puebla prepares for the Golf”, August 5, 2026.

[8] C&EN, “BASF is cutting back at its main site in Germany”, February 2023. cen.acs.org

[9] BASF, “BASF drives forward structural adjustments at the Ludwigshafen site and closes production plants for adipic acid, CDon and CPon”, news release P-24-269, August 29, 2024.

[10] BASF, “A flagship for chemical production: BASF inaugurates world-scale Verbund site in China”, news release P-26-045, March 26, 2026.

[11] Reuters, “Mercedes-Benz expands Hungarian factory in efficiency drive”, July 13, 2026.

[12] Portfolio.hu, “Bosch to relocate production from Germany to Hungary”, September 3, 2025.

[13] Industry Insider, “Miele announces global restructuring and relocates washing machine production to Poland”, February 24, 2024 (based on Miele announcement).

[14] BMW Group PressClub, “BMW Group to deploy humanoid robots in production in Germany for the first time”, February 27, 2026.

[15] Figure AI, “F.02 Contributed to the Production of 30,000 Cars at BMW”, November 19, 2025. figure.ai

[16] NEURA Robotics / InterAlpen Partners, “NEURA + AURONIQ: Cognitive Robotics, Delivered”, March 18, 2026.

[17] AFP via Tech Xplore, “AI-powered robots offer new hope to German factories”, April 22, 2026 (citing a Bitkom survey). techxplore.com

[18] Robotics 24/7, “Humanoid, Siemens complete proof of concept to test humanoid robots in industrial logistics”, January 16, 2026. robotics247.com

[19] Drives & Controls, “Schaeffler-Humanoid deal could deliver more than 50,000 robots”, May 15, 2026. drivesncontrols.com

[20] Auroniq Robotics, “AURONIQ ROBOTICS wins ‘Productivity Award for SMEs’”, May 30, 2026.



argonandco.com